

$$h(m, n) = \begin{cases} 1/81 & \text{for } |m| \leq 4 \text{ and } |n| \leq 4 \\ 0 & \text{otherwise} \end{cases}$$

Identity Used:

$$\sin(x) = \frac{e^{ix} - e^{-ix}}{2i}$$

$$\cos(x) = \frac{e^{ix} + e^{-ix}}{2}$$

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Lab 1 Work

Apply formula for DSFT & Simplify:

$$H(e^{j\mu}, e^{j\nu}) = \sum_{n=-\infty}^{\infty} \sum_{m=-\infty}^{\infty} h(m, n) e^{-j(\mu m + \nu n)}$$

$$= \sum_{n=-4}^4 \sum_{m=-4}^4 \frac{1}{81} e^{-j(\mu m + \nu n)}$$

$$= \frac{1}{81} \sum_{n=-4}^4 e^{-j\nu n} \sum_{m=-4}^4 e^{-j\mu m}$$

$$= \frac{1}{81} \left[ (1 + e^{-4j\mu} + e^{4j\mu} + e^{-3j\mu} + e^{3j\mu} + e^{-2j\mu} + e^{2j\mu} + e^{-j\mu} + e^{j\mu}) \dots \right. \\ \left. (1 + e^{-4j\nu} + e^{4j\nu} + e^{-3j\nu} + e^{3j\nu} + e^{-2j\nu} + e^{2j\nu} + e^{-j\nu} + e^{j\nu}) \right]$$

$$= \frac{1}{81} \left[ (1 + 2\cos(4\mu) + 2\cos(3\mu) + 2\cos(2\mu) + 2\cos(\mu)) \dots \right. \\ \left. (1 + 2\cos(4\nu) + 2\cos(3\nu) + 2\cos(2\nu) + 2\cos(\nu)) \right]$$

$$= \frac{1}{81} \left[ \left(1 + 2 \sum_{k=1}^4 \cos(k\mu)\right) \left(1 + 2 \sum_{l=1}^4 \cos(l\nu)\right) \right]$$